Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	MM Docket No. 99-25
	)	
Creation of a Low Power	)	RM-9208
Radio Service	)	RM-9242
	)	

To: The Commission

REPLY COMMENTS OF THE CONSUMER ELECTRONICS MANUFACTURERS ASSOCIATION

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The Consumer Electronics Manufacturers Association ("CEMA"), by its attorneys and pursuant to Section 1.415 of the Commission's Rules, 47 C.F.R. § 1.415, hereby respectfully submits its reply comments[1] in the above-captioned Notice of Proposed Rulemaking ("NPRM").[2]

I. INTRODUCTION AND SUMMARY

In its initial comments in this proceeding, CEMA did not oppose the creation of a low power FM radio ("LPFM") service, but urged the Commission to ensure that the creation of LPFM does not result in the degradation of FM radio service to the listening public and does not threaten the development and deployment of future terrestrial digital audio radio services.[3]

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1 The Commission extended the reply comment period in this proceeding to September 17, 1999. *See In the Matter of Creation of a Low Power Radio Service*, MM Docket No. 99-25, Order, FCC 99-233 (rel. Aug. 31, 1999).

2 *See In the Matter of Creation of a Low Power Radio Service*, MM Docket No. 99-25 (RM-9208; RM-9242), Notice of Proposed Rulemaking, FCC 99-6 (rel. Feb. 3, 1999) ("*NPRM*").

3 *See* CEMA Comments (filed Aug. 2, 1999).

In an effort to assist the Commission evaluate LPFM's potential interference with current FM receivers, CEMA, with support of National Public Radio and the Corporation for Public Broadcasting, conducted an engineering study to investigate how the addition of low power radio stations to the FM dial would affect the ability of listeners to receive commercial and noncommercial stations.[4] The study, which was submitted with CEMA's comments in this proceeding, considered the effects of the proposal on the selectivity of 16 receivers (five automobile, six portable, and five home stereo receivers). As CEMA informed the Commission, the results of this study found that extensive, objectionable interference to FM reception would occur to current receivers if the LPFM service were deployed as proposed. Additionally, the interference tests showed that the development of terrestrial digital audio radio service could be limited by the addition of numerous new facilities operating on the FM band. Thus, based on the technical evidence developed, CEMA recommended to the Commission that it retain both 2nd- and 3rd- adjacent channel protections to prevent harmful interference to FM receivers and protect the viability of future terrestrial digital audio radio services.

In the reply comments that follow, CEMA provides its analysis and evaluation of interference tests conducted by other parties and finds that the laboratory test data submitted by other parties, including that conducted by the Commission, on FM receiver performance requires further assessments of methods and interference metrics to derive meaningful conclusions. CEMA maintains that the interference data it submitted in its initial comments are the most definitive and reliable over and above other studies submitted, including the Commission's own study. Additionally, CEMA concurs with the National Association of Broadcasters' ("NAB")

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4 *See* CEMA Comments, Exhibit A (Thomas B. Keller and Robert W. McCutcheon, "FM Receiver Interference Tests: Laboratory Test Resport," published by the Consumer Electronics Manufacturers Association (1999)).

contention that, if LPFM is deployed as proposed, full-power stations will face additional interference beyond their protected contours – a result which CEMA believes is detrimental to the listening public's interest. Finally, CEMA urges the Commission to further explore the use of the AM band for low power service, given the significant interference problems that LPFM is likely to produce in the FM band.

II. THE EMPIRICAL EVIDENCE SUBMITTED IN THIS PROCEEDING DEMONSTRATES THAT THE CREATION OF LOW POWER FM, AS PROPOSED, COULD SIGNIFICANTLY HARM EXISTING AND FUTURE FM SERVICE AND THREATEN THE INTRODUCTION OF TERRESTRIAL DIGITAL AUDIO BROADCASTING.

As a general matter, the Commission must insure that all technical issues are adequately addressed in order to maintain the integrity of the radio spectrum.[5] The Commission, in proposing to create new classes of stations in order to promote its laudable goals of fostering diversity of voices and increasing new broadcast ownership, must remain mindful of its fundamental obligation to ensure that any proposed rules do not serve to impair the quality of FM radio services enjoyed by the public today. Additionally, the Commission should ensure that LPFM does not hinder the potential transition of existing broadcasters from analog to digital.

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5 *See* Lucent Technologies Comments at i ("The expert opinions of the Consumer Electronics Manufacturers Association (CEMA), the National Association of Broadcasters (NAB), the Society of Broadcast Engineers (SBE), and possibly other similar expert entities should be carefully considered."); Cox Radio, Inc. Reply Comments at 2 (filed September 14, 1999) ("Cox respectfully urges the Commission to refrain from implementing the proposed LPFM service at least until the completion of a rigorous economic and technical study that, at a minimum, would address the issues raised in NAB's and CEMA's technical evaluations.").

CEMA's concerns about potential interference in the FM band are shared by a large number of commenters.[6] Cox Radio, for example, contends that the Commission's proposal to relax FM interference protections "would be disastrous."[7] Cox Radio observes that the FCC does not offer any steps to ensure that existing FM stations and their listeners would be protected.[8] Additionally, NAB points out that "the Commission apparently did not seek out any receiver experts when developing its conclusions about receiver performance. Instead, it relied on unsubstantiated claims by low power FM proponents that second and third adjacent channel protections are no longer necessary . . . ."[9] Like CEMA, NAB concluded from its interference tests that second and third adjacent channel interference protections are necessary.[10]

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6 *E.g.*, Ohio State University Comments (expresses concern that the LPFM proposal will unduly interfere with signals of existing full-power stations and, therefore, "urges the FCC to conduct a searching inquiry into the technical feasibility and impact of its proposal and to develop a record upon which such a determination can appropriately be made"); Evans Associates, Consulting Engineers Comments ("we are not convinced that second- and third-adjacent channel protection requirements should be disposed of entirely"); University of Dayton ("while there is merit to the creation of LPFM, these matters should be carefully addressed and that the integrity of the broadcast signals of all current full power radio stations, as well as any associated FM translator stations, should not be compromised"); Nassau Broadcasting Partners Comments (same); Morris Broadcasting Company Comments (same); De La Hunt Broadcasting Comments (believes that a new LPFM service would cause serious harm to existing FM radio service); Mix 103.7 Comments (there is potential for interference); L A Radio, Inc. (expresses concern about proposed relaxation of second and third adjacent channel requirements).

Other commenters completely reject the Commission's proposal to create a low power FM service because of interference concerns. *See, e.g.*, State of Oregon Comments; New Jersey Broadcasters Association Comments; Barnstable Broadcasting, Inc. Comments.

7 *See* Cox Radio Comments at i.

8 *Id.* at 3-7.

9 NAB Comments at 17.

10 *Id.* at 28.

Many commenters also share CEMA's concern that LPFM could have the unintended effect of hindering the development of digital audio broadcasting.[11] Lucent's analysis of interference issues, for one, suggests that it will be difficult for additional low power analog and new digital IBOC signals to co-exist and serve their intended service areas.[12]

CEMA concurs with the view expressed by the Association of Federal Communications Consulting Engineers that "[a] proposal as significant as the elimination of third and/or second adjacent channel protection must be supported by technical data showing why the protection is no longer needed."[13] Further, CEMA agrees that "[t]he burden of proof should be on those seeking to eliminate protection, not on those whose facilities were designed under the presumption of protection."[14]

Attached to these reply comments as Appendix A is a report entitled "Review of Laboratory Test Methods And Results Submitted to the Record of MM Docket No. 99-25." This report analyzes the methods and interference metrics used in the laboratory test results submitted by NAB, Broadcast Signal Lab, the FCC, and CEMA. The record in this proceeding contains mixed opinions about the susceptibility of FM receivers to interference and, consequently, disparate views about the viability of LPFM to be implemented with minimal impact on existing

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11 *See, e.g.*, Lucent Technologies Comments at i ("[T]he effect of any changes to the Commission's technical rules governing the FM service must not preclude the ability of broadcasters to initiate digital broadcasting in a consumer-friendly manner").

12 *Id. Accord* Brill Media Company Comments ("[T]he advent of IBOC would be dramatically jeopardized if LPFM operations are authorized without concern for creating interference to second adjacent channels."); Journal Broadcast Group Comments (asserts that the LPFM proposal could end the possibility of a compatible digital service within the existing FM band).

13 Association of Federal Communications Consulting Engineers Comments at 1.

14 *Id.*

FM service. Accordingly, CEMA recommends that the laboratory tests data on FM Receiver Performance will require further assessments of methods and interference metrics to derive meaningful conclusions. This is not surprising since no two laboratories used identical procedures and determining metrics of interference.

The data results CEMA filed were based on the internationally accepted FM receiver test and measurement procedures adopted by the ITU-R. CEMA urges the Commission to consider these results as the most definitive and reliable data over and above the other studies submitted, including the Commission's own study. Appendix A develops, in a technically competent fashion:

- the need for full characterization tests on receiver samples;
- analysis of (and rationale for the superiority of) using the ITU-R Weighted Quasi-Peak and Signal-to-Noise measurement metric for interference analysis, with comparisons to results derived using Weighted Signal-to-Noise or Total Harmonic Distortion + Noise methods;
- comparison of 2nd-adjacent and 3rd-adjacent test results;
- particular questions to be posed to testing laboratories on measurement methods that are unclear, vague or not defined which greatly impact the reported results, or in some cases explain reasons why disparate results were reported.

After considering these issues, CEMA believes that the Commission's technical staff can readily assess the veracity of the CEMA laboratory tests, and we encourage any subsequent testing efforts to follow these procedures. CEMA notes again that, additionally, intermodulation and co-channel interference mechanisms should be considered and weighed heavily in the ultimate determination of LPFM interference impact.

The ultimate conclusions to be reached from the attached information are as CEMA has previously submitted – *i.e.*, LPFM will result in extensive objectionable interference to the reception of existing FM signals if LPFM is deployed as the Commission has proposed.[15]

III. THE ABILITY OF THE LISTENING PUBLIC TO RECEIVE FM BROADCAST SERVICE BEYOND THE PROTECTED CONTOURS OF FULL-POWER STATIONS IS ALSO LIKELY TO BE SIGNIFICANTLY AFFECTED BY THE PROPOSED LPFM SERVICE.

The Commission's consideration of interference issues should not be limited to license coverage areas. The public purchases receivers with the expectation that it will be able to receive programming from certain stations, regardless of whether those listeners happen to be within a particular signal contour recognized by the regulator or not. CEMA concurs with NAB's contention that full-power stations will face additional interference beyond their protected contours if LPFM is implemented as proposed.[16] This is a significant concern, given that many listeners -- increasingly, due to the increased mobility of our society -- have an expectation that

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15 CEMA must take this opportunity to reject the implications cast by certain parties that the need for continued interference protections must be laid at the feet of receiver manufacturers for not fully implementing advanced technologies that would obviate such protections. *See, e.g.*, NAB Comments at 35. Receiver manufacturers operate in a highly competitive market, where trade-offs must be made in terms of cost, price, and product capabilities. Just as broadcasters have developed their market strategies based on certain expectations about the regulatory and interference environments in which they provide service, manufacturers have developed receivers based on similar expectations in order to offer a range of products to consumers that meet their needs at the prices they wish to pay. In that context, products that do not offer adequate interference-free reception will not survive in the marketplace. It defies logic to suggest -- without regard to the expectations mentioned above -- that it was somehow incumbent upon manufacturers to unilaterally raise the bar with respect to the baseline susceptibility to interference of the embedded FM receiver base. That susceptibility, however, must now be a decisive factor in the Commission's decision whether to go forward with its LPFM proposal.

16 NAB Comments at 41-43.

they will continue to receive the broadcasts of their favorite stations beyond the station's protected contour of 60 dBu. As NAB states:

> There is no brick wall that a signal hits at the 60 dBu contour that prevents listeners from receiving the signal outside of that area. In many instances, broadcasters depend on those listeners that are outside of their protected contours and the listeners depend on receiving that signal. As urban areas continue to spread and individuals have to commute and travel, there is an increasing expectation that listeners will be able to receive usable signals beyond their protected contour.[17]

Although the Commission only protects a station's signal to the 60 dBu contour, it has recognized that usable service outside of the area does occur.[18] Because the public continues to be served in these areas, the LPFM proposal (as NAB also contends) threatens to create new interference in areas that now receive service, resulting in loss of service to large numbers of listeners.[19] CEMA believes that such a result would lead to consumer confusion and disruption in the FM service and receiver markets, and would ultimately lead to listener accusations that the government rather than the consumer had determined that programming from a nearby low-power station was more deserving of reception than that from a neighboring city, town, or suburb. Dissatisfaction with the loss of previously received programming will have an adverse effect on both the FM service and the receiver markets. The consequent reduction in the size of the listening audience cannot be considered in the public interest.

This interference concern was studied by the North Carolina Association of Broadcasters and the Virginia Association of Broadcasters. These broadcasters found that a significant portion

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17 *Id.* at 41.

18 *See Amendment of Part 73 of the Rules to Provide an Additional FM Station Class (Class C3) and to Increase the Maximum Transmitting Power for Class A FM Stations*, Notice of Proposed Rulemaking, 3 FCC Rcd 5941, 5950 (1988). *See also* NAB Comments at 42 (citing same).

19 *See* NAB Comments at 42.

of listening does occur outside the protected contour and that the stations would be adversely affected by the LPFM proposal.[20] CEMA urges the Commission to address this significant concern and not to implement any LPFM regime that has the effect of seriously disrupting the programming choices of a large fraction of the FM listening public.

IV. GIVEN THE SIGNIFICANT CONCERNS OVER INTERFERENCE ISSUES, THE COMMISSION SHOULD FURTHER EXPLORE THE POSSIBILITY OF CREATING LOW POWER SERVICE IN THE AM BAND.

CEMA genuinely supports the concept of community radio, even in the FM band, but not at the expense of sacrificing the integrity of the FM band and the interests of the listening public. Because of significant interference problems that LPFM is likely to cause in the FM band, CEMA urges the Commission to explore the possibilities for the creation of low power service in the AM band, which appears to be underutilized. Although there remains a large number of AM licensees, many AM stations have "gone dark" in recent years, with the result that, in many areas, a substantial portion of the AM band is fallow. CEMA urges the Commission to explore the possibility of reorganizing the AM band so that, for example, high-powered incumbent stations could be situated at one end of the band and new low power stations could be licensed at the other end. While such an approach may conceivably raise technical issues that would have to be addressed, CEMA believes such reorganization of the AM band would serve both to minimize the potential interference concerns that could be raised by incumbents and to foster more

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20 Comments of the North Carolina Association of Broadcasters and Virginia Association of Broadcasters at 25 (filed Aug. 2, 1999). *See* NAB Comments at 42; WNYC Radio Reply Comment at 2 (filed Sept. 3, 1999) ("WNYC-FM is able to serve many . . . commuters because the dense lattice of signal in the northeast has grown in a way, with help of FCC regulations on adjacent and co-channel interference, that permits our signal to be heard well beyond our protected contour. Based on Arbitron data, we estimate that we have 89,500 weekly listeners to our FM station in countries outside or straddling the protected contour.").

efficient utilization of the potentially highly valuable AM spectrum, while furthering the social goals the Commission seeks in sponsoring a new effort to promote community radio. The new stations would also be receivable across much of the embedded AM/FM receiver base. Before moving forward on the LPFM proposal – which CEMA strongly believes must be abandoned or significantly modified because of the interference concerns described above and elsewhere in the record of this proceeding – the Commission must explore alternatives, such as AM reorganization, to see if a less disruptive means can be found to achieve its goals.

V. CONCLUSION

For the reasons stated in the foregoing and in its initial comments in this proceeding, CEMA urges the Commission to ensure that any new low power FM radio service will protect existing FM radio services, including service received by listeners beyond a station's protected

contour. Further, CEMA urges the Commission to further evaluate the viability of creating low power service in the AM band.

Respectfully submitted,

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Review of Laboratory Test Methods and Results of FM Receiver Measurements Submitted to the Record in MM Docket No. 99-25

Prepared for CEMA by Thomas B. Keller, T. Keller Corp.

September 16, 1999

1. Receivers

The most important element in interference testing is the selection and characterization of sample receivers. This provides a basic understanding of the full performance of receivers and establishes a baseline performance level to weigh the meaningfullness and relevancy of subsequent interference test results. The sample should include a cross section of receivers that are generally used in an environment that would not mask the effects of interference. The following is a summary of the receiver selection made by each laboratory and a review of their reported receiver certification tests:

Broadcast Signal Lab used 11 receivers for the tests. Six of the receivers used VFO or analog tuning. Only one of the receivers was purchased in 1998, and the remaining 10 purchased prior to 1998. Receiver characterization tests were not reported.

NAB had a large sample (28) and a broad mix of receivers. Their sample included five monophonic clock radios. Limited receiver characterization tests (RF level/S/N) were conducted.

CEMA used 16 receivers for the test sample. The mix consisted of auto, component, personal portables, and the new single chip receivers. The single chip receiver is being widely marked at the present time. Fifteen characterization tests were conducted on each receiver. These tests measured the local oscillator frequency, set a standard audio output level, found the input overload point, measured AM rejection, measured image rejection, ploted S/N vs RF level curves, measured capture ratio, measured 1st, 2nd, and 3rd adjacent interference, measured 10.7 MHz rejection, 10.7 MHz intermodulation (IM) and 10.7 MHz local oscillator interference.

The FCC created three receiver categories:

I. Small, inexpensive receivers with integral antenna
II. Small, moderate-cost receivers with antenna connection
III. Dash-mount automobile receivers

Because of the complexity of coupling the RF to the input of receivers with integral antennas, the FCC did not test any category I receivers. In the test

performed by the three other labs, BSL, CEMA, and NAB, the FCC category I type receivers were the most susceptible to adjacent channel interference. The FCC also noted that category III (auto) receivers were the least sensitive to 2nd and 3rd adjacent interference. These finding are confirmed by BSL, CEMA, and NAB laboratory test results.

The FCC did 50 dB quieting tests on each receiver.

2. Interference Measurement Methodology

The metric used for measuring interference by the four labs is listed in the following table.

Table 1
Interference Measurement Metric for each Laboratory

	WQP S/N	Weighted S/N	THD + noise
CEMA	X		
NAB	X		
BSL		X (assumption)	X
FCC			X

Obviously, using different measurement methodology makes it difficult if not impossible to compare the laboratory test results. Two basic measurement methods were used, S/N and THD. The noise tests were divided into WQP S/N and Weighted RMS S/N.

Total Harmonic Distortion & Signal-to-Noise (THD & S/N)

To compare S/N and THD as an interference metric, the test performed by Broadcast Signal Lab and the results reported by it under Tab G, Appendix G illustrate the differences. Six of the tests are summarized in Tables 2 through 7 of these comments. It can be clearly seen that small changes in distortion do not represent larger changes in S/N. As an example in Table 3 the performance of receiver #1 can be compared with the performance of receiver #8. Receiver #1 S/N is 13 dB higher than receiver #8 but the distortion has only changed by 1.3%. In Table 3 receiver #1 S/N is 18 dB higher than receiver #11 but the distortion has changed by a little over 4%. Other examples can be found in tables #3 through #8.

Weighted Quasi-Peak (WQP) Detection Measurements

ITU-R Recommendation [cite from CEMA comments] is the internationally recognized method to measure FM interference. This recommendation uses the combination of quasi-peak detection and the ITU-R weighting filter that yields S/N ratio measurements that more accurately correlate to perceived program audio interference. The quasi-peak detection will measure the audible peaks that are associated with adjacent channel interference that would be missed by RMS measurements.

3. Comparison of 2nd Adjacent Test Results

CEMA/NAB

The CEMA and NAB used target S/N tests to determine D/U ratios. For the CEMA tests the undesired signal was increased until the target WQP audio S/N of 45 dB was attained. The D/U was recorded at this point. The NAB used a target WQP S/N of 50 dB for this test. If without interference the receiver S/N was lower than 55 dB, the NAB lab increased the undesired signal level until a reduction of 5 dB in S/N was measured. The D/U was recorded at this point. Both laboratories used noise for the undesired signal and weighted quasi-peak noise measurements. CEMA averaged the receiver test results, and the NAB found the median. Table #2 shows that for the test conditions listed the test results were within 2 dB.

Table #2
2nd Adjacent Test Results Comparison
CEMA/NAB

No	Target S/N	D/U at Target D/U
1	CEMA 45 dB S/N	-26 dB Average (-50 dBm)
2	NAB 50 dB S/N	-24 dB Median (-55 dBm)

CEMA/FCC

CEMA and the FCC used differing methodology for measuring interference. CEMA used WQP S/N as the quality measuring metric, and the FCC used THD. The FCC laboratory D/U average at 1% distortion is –47 dB for 2nd adjacent interference (60 dB contour). CEMA measured 28 dB S/N at a D/U of –50 dB with five receivers failing.

CEMA/BSL

For the analysis of the BSL data in the tables was taken directly from the Broadcast Signal Lab, laboratory tests report Tab G, Appendix G, Data Tables.

Table 3
2nd Adjacent THD and S/N
-40 dB D/U FCC
Undesired Signal Stereo Tone
BSL Test Data

	S/N dB	THD %
1. Marantz	54	.69
2. Sony Sports	No data	No data
3. Toyota auto	50	.62
4. Denon tuner	45.5	.75
5. Sony clock	45.8	2.6
6. Aiwa boombox	0 c	C
7. Sony boombox	20	13
8. Technics component	41	2

9. NAD tuner	51	.54
10. Ford auto	64.5	0.58
11. Aiwa integrated system	39.9	3.36

The above data results were derived using the FCC 2nd adjacent protection radio (D/U) of -40 dB.

Three of the low price receivers listed in Table 3 failed (receivers 2, 6, & 8). Receiver #11, the integrated system, had very poor S/N. Receiver #5, a mono clock radio, showed the improved performance that is expected from a monophonic radio. For the same D/U tests CEMA had four out of sixteen receivers fail.

Table 4 2nd Adjacent THD and S/N –50 dB D/U FCC Undesired Signal Stereo Tone BSL Test Data		
	S/N dB	THD %
1. Marantz	48	.73
2. Sony Sports	No data	No data
3. Toyota auto	50.3	0.7
4. Denon tuner	33.3	2.7
5. Sony clock	0	100 c
6. Aiwa boombox	0 c	C
7. Sony boombox	0 b	100 u
8. Technics component	33	1.8
9. NAD tuner	41.2	1.6
10. Ford auto	67.4	.61
11. Aiwa integrated system	30	4.9

With the D/U 10 dB worse than the FCC 2nd adjacent D/U protection ratio, receivers 2, 5, 6, & 7 completely failed. Only the auto receivers survived the –50 dB D/U with tone modulation on the undesired signal.

Table 5 2nd Adjacent THD and S/N –50 dB D/U FCC Undesired Signal Program Audio BSL Test Data		
	S/N dB	THD %
1. Marantz	51	.68
2. Sony Sports	No data	No data
3. Toyota auto	51.1	.67
4. Denon tuner	37.9	2.1
5. Sony clock	0 c	100 u
6. Aiwa boombox	0 c	C
7. Sony boombox	0 u	100 c
8. Technics component	43	1.3
9. NAD tuner	43.5	1.7

10. Ford auto	67.7	0.61
11. Aiwa integrated system	42.1	3.5

The tests in Table 5 were conducted using program material on the undesired channel. The tests in Table 4 were conducted using tone modulation on the undesired channel. The interference should be less with program material on the undesired channel. The –50 dB D/U is held constant for the tests in Table 4 and Table 5. Undesired channel audio modulation was the only change.

Comparing the data in Table 4 with Table 3, none of the four receivers that failed the tests in Table 3 recovered in Table 4 with program modulation on the undesired signal. Receivers 8 and 11 showed significant reduction in audio noise but both receivers still had low S/N ratio. Only three of the receivers had satisfactory S/N ratios with the program modulation and the –50 dB D/U.

2nd Adjacent Conclusion (BSL)

The test conducted by Broadcast Signal Lab confirms the results of the tests conducted by CEMA and the NAB. It is clear that the present –40 dB 2nd adjacent D/U causes interference especially for the lower cost radios. Increasing the interference by 10dB (-50 dB D/U) would make a bad situation even worse.

Use of S/N versus THD for Interference Evaluation

It is also clear from the S/N and THD data shown in Tables 3, 4, and 5 that the use of THD rather than noise as a metric to evaluate the performance of the desired channel with 2nd adjacent interference can be misleading – underestimating the real interference impact.

4. Comparison of 3rd Adjacent Test Results

CEMA/NAB

For the third adjacent tests, CEMA used only a fixed D/U test while NAB used a target noise test approach. The results are not comparable.

CEMA/FCC

CEMA and the FCC used differing methodology for measuring 3rd adjacent interference. CEMA used WQP S/N for the quality measuring metric, and the FCC used THD. The FCC laboratory D/U average at 1% distortion is –57 dB for 2nd adjacent interference. CEMA measured 27 dB S/N at a D/U of –50 dB with four receiver failing.

CEMA/BSL

The following data was taken directly from the Broadcast Signal Lab, laboratory tests report Tab G, Appendix G.

Table 6 3rd Adjacent THD and S/N -40 dB D/U FCC Undesired Signal Stereo Tone BSL Test Data		
	S/N dB	THD %
1. Marantz	42.8	1.0
2. Sony Sports	No data	No data
3. Toyota auto	50.3	0.64
4. Denon tuner	47.6	0.55
5. Sony clock	36.4	4.1
6. Aiwa boombox	O c	100 c
7. Sony boombox	38.9	6.8
8. Technics component	54	0.89
9. NAD tuner	58.5	0.25
10. Ford auto	58.4	0.4
11. Aiwa integrated system	39.6	3.5

The above data were derived using the FCC 3rd adjacent protection ratio (D/U) of -40 dB.

Two of the low price receivers listed in Table 6 failed (receivers 2 & 6). Receiver #1, 5, 7, and 11, had very poor S/N. For the same D/U tests CEMA had two out of sixteen receivers fail.

Table 7 3rd Adjacent THD and S/N -30 dB D/U FCC Undesired Signal Stereo Tone BSL Test Data		
	S/N	THD
1. Marantz	32.5	2.3
2. Sony Sports	No data	No data
3. Toyota auto	50	0.75
4. Denon tuner	33.7	2.1
5. Sony clock	12	60.3 u
6. Aiwa boombox	0 c	C
7. Sony boombox	28.3	19.2
8. Technics component	51.8	0.93
9. NAD tuner	48.4	0.5
10. Ford auto	65.7	0.5
11. Aiwa integrated system	33	4.3

With the D/U 10 dB over the FCC 3rd adjacent D/U protection ratio, receivers 2, 5, & 6 failed. Receivers 1, 4, 7, and 11 were very noisy. Under these 3rd adjacent conditions 7 out of the 11 receivers either failed or were very noisy.

Table 8 3rd Adjacent THD and S/N –50 dB D/U FCC Undesired Signal Program Audio BSL Test Data		
	S/N	THD
1. Marantz	35.2	1.7
2. Sony Sports	No data	No data
3. Toyota auto	51.8	0.6
4. Denon tuner	40.6	1.6
5. Sony clock	18	100 u
6. Aiwa boombox	0 c	100 c
7. Sony boombox	30.2	19
8. Technics component	50	1
9. NAD tuner	52.4	0.4
10. Ford auto	69.9	0.5
11. Aiwa integrated system	36.6	4.1

The tests in Table 8 were conducted using program material on the undesired channel. The tests in Table 7 were conducted using tone modulation on the undesired channel. The interference should be less with program material. The –50 dB D/U is held constant for tests in Table 7 and Table 8. The only change was the undesired channel audio modulation.

Comparing the data test results reported in Table 7 with Table 8 shows that none of the three receivers that failed in Table 7 recovered in Table 8 with program modulation. Only four of the eleven receivers had satisfactory S/N ratios with the program modulation and the –50 dB D/U.

3rd Adjacent Conclusions

The test conducted by Broadcast Signal Lab confirms the results of the tests conducted by CEMA and the NAB. It is clear that the present –40 dB 3rd adjacent D/U protection radio results in extensive interference. Increasing the undesired signal by 10dB would make a bad situation worse.

5. Use of S/N versus THD for Interference Evaluation

It is also clear from the S/N and THD data in Tables 6, 7, and 8 that the use of THD rather than noise as a metric to evaluate the performance of the desired channel with 3rd adjacent interference can be can misleading – underestimating the extent of real interference.

6. Questions that Should be Answered by Testing Laboratories

Significant uncertainties exist when trying to analyze these disparate test results. To better understand the data reported by the different laboratories and understand the reliability of the results, the following questions should be answered:

Test Methodology

Broadcast Signal Lab reported the use of the IEC weighting for the noise measurement tests. Was this filter used with RMS or Quasi Peak detectors?

The FCC lab and BSL performed THD tests, was RMS or Quasi Peak detection used for these measurements?

Calibration

Is calibration data available for either the test equipment or the test bed?

Was a calibrated power meter or other calibration used to confirm the accuracy of the spectrum analyzers?

Was the Besel Null method used to calibrate the modulation monitors?

Test Bed

On page 21 of NAB Exhibit B (Table 2) the signal to noise ratio without interference is reported for each receiver at three signal levels. For the CEMA tests the lowest S/N at the –65 dBm desired signal level was 54 dB. See Table 9 in this document. At this signal level (-65 dBm) NAB had 23 receivers measuring below the 54 S/N. NAB receivers 5, 6, 7, 8, 9, 10, and 14 had extremely poor S/N readings.

Table 9 shows the results of the CEMA receiver S/N noise measurement. At the –65 dBm level the CEMA minimum was 54 dB and maximum 68 dB. At the same signal level the NAB minimum S/N was 17.4 dB and the maximum 58 dB.

Table 9
Signal to Noise Ratio without Interference

CEMA Receiver Number	-45 dBm	-55 dBm	-65 dBm
1	61	61	60
2	73	69	61
3	69	67	62
4	72	70	65
5	66	66	66
6	71	71	66
7	60	60	58
8	70	70	68
9	61	61	57
10	68	68	65
11	60	59	54
12	60	60	57
13	64	63	57
14	63	61	54

15	58	58	55
16	60	60	58

Conclusion

These wide variations are likely caused by problems with input RF coupling. In many cases these high noise levels would have masked determining the onset of interference.